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Model Video Marka-Sweep

KAY ELECTRIC CO.

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KAY ELECTRIC COMPANY

Model Video Marka-Sweep

INSTRUCTION MANUAL

ISSUE A

KAY ELECTRIC CO.

PINE BROOK, N. J.

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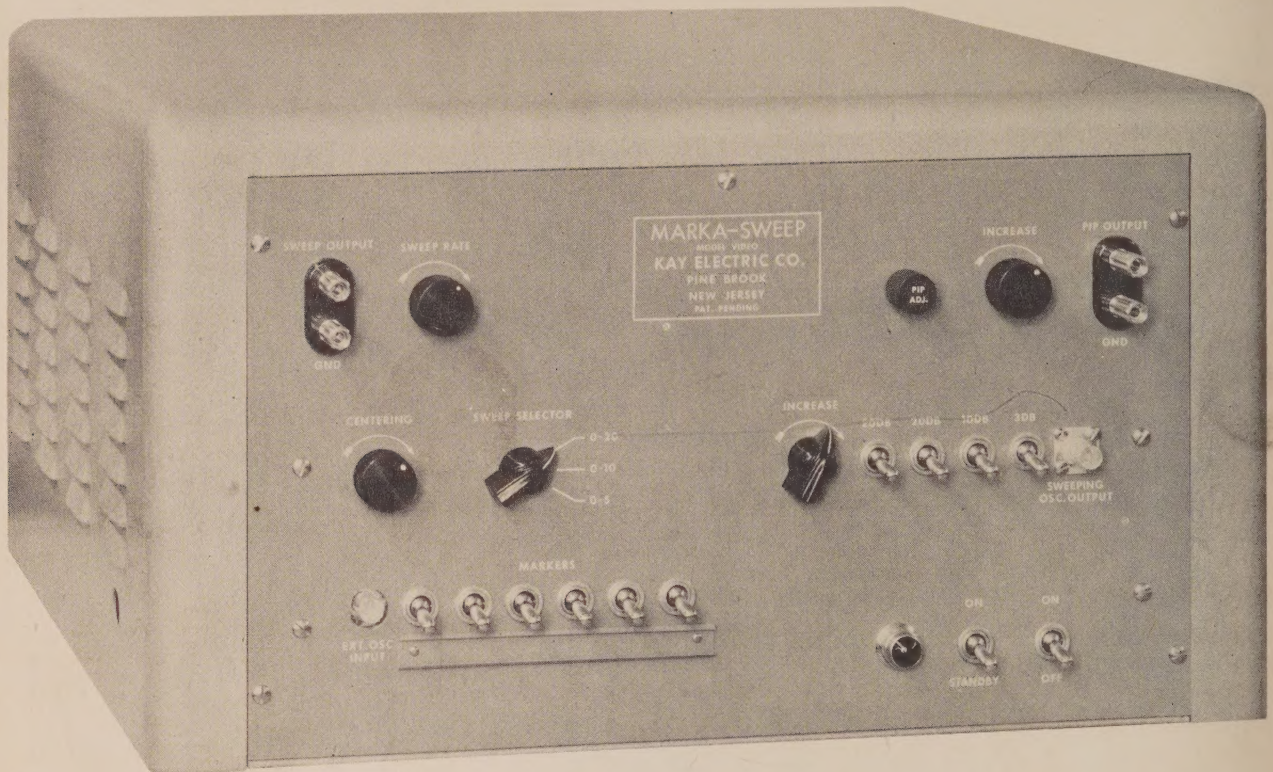


Figure 1. model video MARKA-SWEEP

SECTION I

GENERAL DESCRIPTION

A. APPLICATION.

THE **model video MARKA-SWEEP** IS AN ALL-ELECTRONIC SWEEP GENERATOR DESIGNED FOR USE WITH AN OSCILLOSCOPE TO DEFINE THE FREQUENCY RESPONSE CHARACTERISTICS OF VIDEO CIRCUITS UNDER TEST. THE UNIT PROVIDES A CHOICE OF THREE SWEEP WIDTHS. 0-5 MC, 0-10 MC, OR 0-20 MC. IN ADDITION, THE **model video** PROVIDES A SERIES OF MARKERS FOR FREQUENCY IDENTIFICATION OF VARIOUS POINTS IN THE SWEEP RANGE.

B. DESCRIPTION.

BASICALLY THE **model video MARKA-SWEEP** IS COMPRISED OF SAWTOOTH SWEEP VOLTAGE, SWEEP FREQUENCY, AND FREQUENCY MARKER CIRCUITS. THE UNIT GENERATES A LINEAR 0 TO 20 MC SWEEPING FREQUENCY AT A REPETITION RATE OF APPROXIMATELY 60 CYCLES. IN ADDITION, A SAWTOOTH SWEEP VOLTAGE IS SUPPLIED TO THE HORIZONTAL DEFLECTION CIRCUITS OF THE OSCILLOSCOPE TO ASSURE COMPLETE SYNCHRONIZATION.

FOR IDENTIFICATION OF VARIOUS POINTS ON THE 'SCOPE TRACE, THE UNIT SUPPLIES A SERIES OF SIX FIXED PULSE-TYPE FREQUENCY MARKERS DIRECTLY TO THE OSCILLOSCOPE. THESE CRYSTAL CONTROLLED MARKERS ARE NORMALLY AT 1, 2, 5, 10, 15, AND 20 MC; HOWEVER, OTHER FREQUENCIES MAY BE SUBSTITUTED WHERE REQUIRED.

FOR APPLICATIONS WHERE MEASUREMENT OF FREQUENCIES OTHER THAN THOSE OF THE FIXED CRYSTAL FREQUENCIES IS DESIRED, THE **model video** IS DESIGNED TO USE THE OUTPUT OF A CALIBRATED, EXTERNAL, FREQUENCY GENERATOR TO SYNTHESIZE A VARIABLE MARKER. THE POSITION OF THE MARKER ON THE 'SCOPE TRACE WILL CORRESPOND TO THE FREQUENCY SETTING OF THE EXTERNAL OSCILLATOR.

FREQUENCY STABILITY AND "FLATNESS" OF THE FREQUENCY GENERATING OUTPUT IS ASSURED THROUGH USE OF A HETERODYNE SYSTEM. THE CIRCUIT EMPLOYS A SWEEPING FREQUENCY OSCILLATOR, OPERATING IN THE 60-80 MC REGION, WHOSE OUTPUT IS MIXED WITH A CRYSTAL-CONTROLLED 60-MC SIGNAL TO PRODUCE THE 0-20 MC FREQUENCY OUTPUT OF THE **model video MARKA-SWEEP**. SWEEPING OF THE VARIABLE 60-80 MC OSCILLATOR IS ACCOMPLISHED BY AN ALL-ELECTRONIC SWEEPING SYSTEM, WHICH UTILIZES VARIABLE PERMEABILITY TECHNIQUES.

AN INTERNAL SYNC GENERATOR "LOCKS" THE SAWTOOTH SWEEP VOLTAGE OSCILLATOR TO THE 60-CYCLE LINE FREQUENCY. FOR SPECIAL APPLICATIONS, HUM MEASUREMENTS, ETC., THE SWEEP RATE MAY BE VARIED SLIGHTLY ABOVE OR BELOW 60 CPS.

C. SPECIFICATIONS

1. SWEEPING OUTPUT:

a. RANGES: 50 KC - 5 MC, 50 KC - 10 MC AND 50 KC TO 20 MC.

b. SWEEP WIDTH: COINCIDES WITH SWEEPING RANGE IN USE.

c. AMPLITUDE MODULATION WHILE SWEEPING: TO 10 DB, LESS THAN 0.05 DB/MC; TO 20 DB, LESS THAN 0.1 DB/MC.

d. OUTPUT AMPLITUDE: 0.3 VOLTS INTO 72 OHMS.

e. OUTPUT CONTROL: SWITCHED ATTENUATORS AT 20 DB, 20 DB, 10 DB, AND 3 DB; VARIABLE ATTENUATOR WITH 6-DB RANGE.

2. MARKER OUTPUT:

a. FIXED CRYSTAL-POSITIONED, PULSE-TYPE MARKERS AT 1.0, 2.0, 5.0, 10.0, 15.0 AND 20.0 MC.

b. VARIABLE MARKER: OBTAINABLE BY USING EXTERNAL SIGNAL GENERATOR AS ACCESSARY. MINIMUM OF 0.1 VOLT OUTPUT OVER RANGE OF 0-20 MC REQUIRED.

c. MARKER OUTPUT VOLTAGE: POSITIVE PULSE, APPROXIMATELY 5.0 VOLTS RMS.

d. OUTPUT CONTROL: CONTINUOUSLY VARIABLE, ZERO-MAXIMUM. SEPARATE MARKER AMPLITUDE CONTROL.

3. SWEEP OUTPUT: REGULAR SAWTOOTH - PROVIDES HORIZONTAL SWEEP VOLTAGE FOR 'SCOPE. REPETITION RATE VARIABLE OVER 50-100 CPS RANGE. MAY BE LOCKED TO 60-CPS LINE FREQUENCY.

4. POWER SUPPLY:

a. EARLIER EQUIPMENTS: MODEL #397

b. AFTER JAN. 1, 1955: MODEL #200A

c. INPUT: APPROXIMATELY 170 WATTS, 117-VOLT ($\pm 10\%$), 50-60 CPS A-C POWER

d. OUTPUTS: ELECTRONICALLY-REGULATED B+ AND FILAMENT VOLTAGES.

5. TUBE COMPLEMENT.

R-F CIRCUITS:	3 - 6AH6	3 - 12AT7
	1 - 6J6	2 - 12AU7
	1 - 6V6	1 - 5963

POWER SUPPLY (200A):	1 - 5U4G	1 - 12AU7
	1 - 6AG5	1 - OB2
	3 - 6AQ5	

POWER SUPPLY (397): 1 - 5U4 2 - 6Y6
1 - 6J5 1 - VR-150
1 - 6SL7

6. DIMENSIONS: $18\frac{1}{2}$ " x 20 " x $10\frac{1}{2}$ "

7. WEIGHT: 60 POUNDS.

D. STANDARD COMPONENTS SUPPLIED.

1. **model video MARKA-SWEEP**, COMPLETE WITH TUBES AND CRYSTALS (STANDARD OR AS SPECIFIED).
2. REGULATED POWER SUPPLY.
3. CABINET.
4. INSTRUCTION BOOK.

E. ADDITIONAL EQUIPMENT REQUIRED.

1. OSCILLOSCOPE.

60 Mc. 80 Mc
2. ~~50 MC TO 20 MC~~ CALIBRATED OSCILLATOR, 0.1 VOLT OUTPUT FOR CONTINUOUSLY VARIABLE FREQUENCY MARKER.

3. ADDITIONAL MARKER CRYSTALS, WHEN SPECIAL MARKERS ARE REQUIRED.

4. DETECTOR CIRCUIT, FOR USE WITH AN OSCILLOSCOPE HAVING INSUFFICIENT VERTICAL AMPLIFIER BANDWIDTH (SEE figure 3).

1 - CK-705A GERMANIUM CRYSTAL DIODE

1 - 33K, $\frac{1}{2}$ WATT RESISTOR, NON-INDUCTIVE

1 - .001 μ f CAPACITOR

5. ISOLATION RESISTOR, NON-INDUCTIVE, 47 K, 1 WATT (SEE figure 2).

6. LOAD RESISTOR, FOR AMPLIFIER UNDER TEST. (VALUE DETERMINED BY DESIGN OF AMPLIFIER.)

7. INTERCONNECTING CABLES.

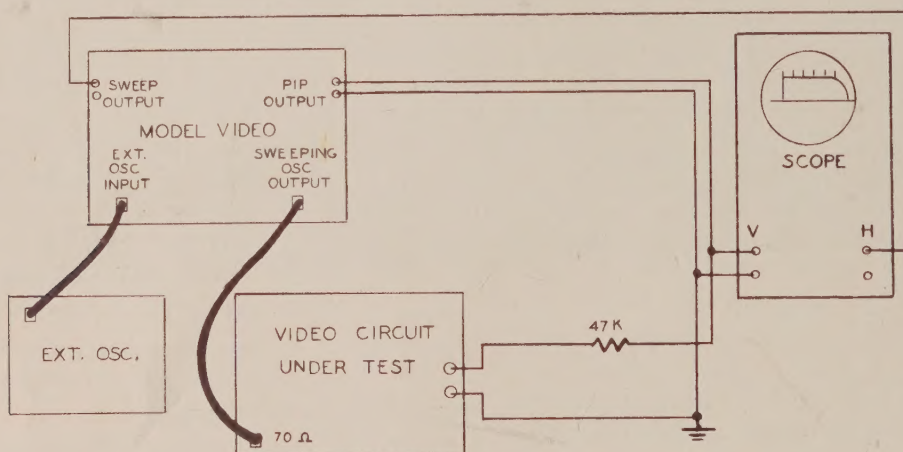
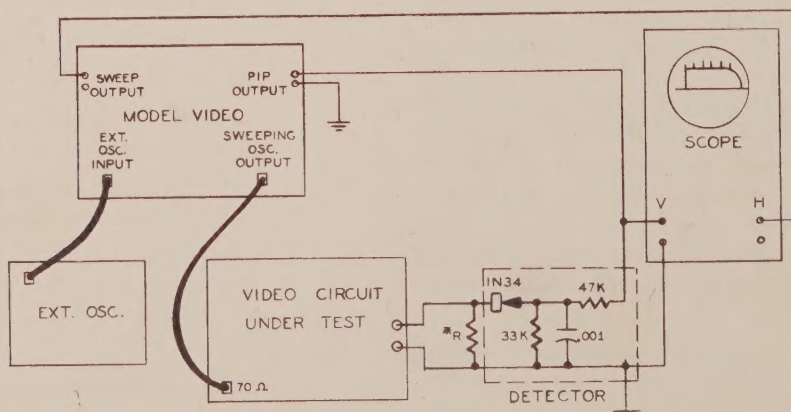


Figure 2. Interconnecting Block Diagram, Wide Band Scope



* VALUE DETERMINED BY LOAD REQUIREMENT OF CIRCUIT UNDER TEST

Figure 3. Interconnecting Block Diagram, Narrow Band Scope

SECTION II INSTALLION

A. GENERAL.

THE **model video MARKA-SWEEP** IS DESIGNED FOR TABLE-TOP OPERATION. NO SPECIAL INSTALLATION PROBLEMS SHOULD BE ENCOUNTERED. HOWEVER, THE FOLLOWING PRECAUTIONS SHOULD BE OBSERVED IN CHOOSING A PERMANENT LOCATION FOR THE UNIT:

1. SELECT A LOCATION WHERE THE EQUIPMENT WILL NOT BE SUBJECTED TO EXCESSIVE HEAT, MOISTURE, OR MECHANICAL DISTURBANCE.
2. A CABINET COOLING FAN IS MOUNTED AT THE REAR OF THE UNIT; BE SURE THERE IS SUFFICIENT CLEARANCE AT THE REAR OF THE CABINET FOR ADEQUATE VENTILATION.
3. THE UNIT REQUIRES CONNECTIONS TO A 117-V, 60 CYCLE, POWER SOURCE; TO AN OSCILLOSCOPE; TO A CALIBRATED MARKER OSCILLATOR (WHEN USED); AND THE VIDEO CIRCUIT UNDER TEST. CABLING TO THE VIDEO CIRCUIT UNDER TEST SHOULD BE AS SHORT AS POSSIBLE AND PROPERLY TERMINATED.

B. INTERCONNECTION DATA.

1. OSCILLOSCOPE CONNECTIONS.
 - a. IF THE BANDPASS CHARACTERISTICS OF THE OSCILLOSCOPE'S VERTICAL DEFLECTION CIRCUITS *are as wide as* THE VIDEO AMPLIFIER OR CIRCUIT UNDER TEST, THE EQUIPMENT SHOULD BE CONNECTED AS SHOWN IN *figure 2*. A 47K, $\frac{1}{2}$ WATT RESISTOR SHOULD BE CONNECTED IN SERIES WITH THE OUTPUT OF THE VIDEO EQUIP-

MENT UNDER TEST TO PROVIDE ISOLATION FOR THE MARKER PULSE CIRCUIT.

- b. IF THE BANDWIDTH OF VERTICAL DEFLECTION CIRCUITS OF THE OSCILLOSCOPE IS LESS THAN THAT OF THE VIDEO CIRCUIT UNDER TEST, A DETECTOR CIRCUIT SHOULD BE EMPLOYED AS SHOWN IN *figure 3*. THE VALUE OF R, IN *figure 3*, WILL BE DETERMINED BY THE LOAD IMPEDANCE REQUIREMENTS OF THE VIDEO CIRCUIT UNDER TEST.

2. VARIABLE FREQUENCY MARKER. WHEN A CONTINUOUSLY VARIABLE FREQUENCY MARKER PULSE IS DESIRED, AN EXTERNAL 50-KC TO 20-MC SIGNAL GENERATOR IS REQUIRED. THIS GENERATOR SHOULD HAVE AN OUTPUT OF 0.1 VOLTS RMS AND BE CONNECTED TO THE EXTERNAL OSCILLATOR INPUT JACK ON THE FRONT PANEL OF THE **model video**. IF THE CONNECTING CABLE IS MORE THAN A FEW FEET IN LENGTH, LOW CAPACITY CABLE SHOULD BE SELECTED.

3. FIXED FREQUENCY MARKERS. THE STANDARD **model video MARKA-SWEEP** UNIT IS FACTORY EQUIPPED WITH A SET OF SIX MARKER CRYSTALS. THESE CRYSTALS ARE RESONANT AT 61.0, 62.0, 65.0, 70.0, 75.0, AND 80.0 MC, PROVIDING MARKERS ON THE OSCILLOSCOPE DISPLAY AT 1.0, 2.0, 5.0, 10.0, 15.0, AND 20.0 MC.

IF ANY OF THE STANDARD MARKERS ARE TO BE CHANGED, SIMPLY REPLACE THE CORRESPONDING CRYSTAL WITH A NEW CRYSTAL CUT TO A FREQUENCY 60 MC ABOVE THE DESIRED MARKER FREQUENCY.

SECTION III OPERATING INSTRUCTIONS

A. DESCRIPTION OF CONTROLS

THE FOLLOWING IS A BRIEF DESCRIPTION OF EACH CONTROL AND ITS FUNCTION. OPERATION OF THE CONTROL IS DESCRIBED IN PARAGRAPH B OF THIS SECTION.

1. POWER ON-OFF SWITCH (S-14). THIS SWITCH CONTROLS ALL A-C POWER TO THE EQUIPMENT. WHEN THIS SWITCH IS IN THE ON POSITION, THE ADJACENT RED PILOT LIGHT COMES ON, INDICATING THAT THE POWER SUPPLY AND ALL FILAMENT CIRCUITS ARE ENERGIZED.
2. ON-STANDBY SWITCH (S-13). WHEN THIS SWITCH IS IN THE STANDBY POSITION, ALL D-C POTENTIALS EXCEPT THOSE IN THE SWEEP GENERATOR STAGE V-2 ARE REMOVED FROM THE UNIT. IN THE ON POSITION, THE **model video** IS IN OPERATION.
3. SWEEP SELECTOR (S-1). THIS ROTARY SWITCH IS USED TO SELECT THE DESIRED SWEEP WIDTH OF

0-5, 0-10 OR 0-20 MC.

4. CENTERING CONTROL (R-26). THIS CONTROL ADJUSTS THE START OF THE SWEEP VOLTAGE EXCURSION TO CORRESPOND TO ZERO FREQUENCY OUTPUT FROM THE SWEEPING FREQUENCY GENERATOR.

5. SWEEP RATE CONTROL (R-10). THE SETTING OF THIS CONTROL DETERMINES THE SAWTOOTH SWEEP VOLTAGE FREQUENCY. IT IS NORMALLY ADJUSTED TO "LOCK-IN" WITH THE 60-CYCLE LINE FREQUENCY; HOWEVER, FOR SPECIAL APPLICATIONS, SUCH AS HUM MEASUREMENT, THE SWEEP VOLTAGE FREQUENCY MAY BE MOVED OUT OF SYNCHRONISM WITH THE POWER LINE BY USE OF THE SWEEP RATE CONTROL.

6. PIP ADJUST CONTROL (R-63). THE PIP ADJUST POTENTIOMETER CONTROLS THE STABILITY OF THE FREQUENCY MARKER PULSES. WITHIN THE RANGE OF THIS CONTROL ARE THE CONDITIONS OF MULTIPLE

PULSES OR ABSENCE OF ALL PULSES: THE CONTROL IS NORMALLY SET TO A POSITION MIDWAY BETWEEN THESE TWO UNDESIRABLE CONDITIONS.

7. INCREASE MARKER LEVEL CONTROL (R-97). THIS CONTROL PROVIDES AN ADJUSTMENT OF THE VOLTAGE LEVEL OF THE FREQUENCY MARKER PULSE PIPS OVER A RANGE OF ZERO TO 5.0 VOLTS (POSITIVE).

8. OUTPUT ATTENUATOR CONTROLS (S-9, S-10, S-11, S-12 AND R-47). A SERIES OF FIXED ATTENUATOR PADS ARE CONTROLLED BY THE SWITCHES DESIGNATED 20 DB, 20 DB, 10 DB AND 3 DB. THE FIXED PADS ARE SWITCHED INTO THE SWEEPING FREQUENCY OUTPUT CIRCUIT WHEN THE SWITCHES ARE IN THE UP POSITION. AN ADDITIONAL 6-DB CONTROL OVER THE OUTPUT IS PROVIDED BY THE VARIABLE INCREASE (R-47) CONTROL.

9. MARKER CONTROLS (S-3 THROUGH S-8). EACH OF THESE TOGGLE SWITCH CONTROLS ONE OF THE SIX FIXED FREQUENCY MARKERS. NORMALLY, THE MARKERS ARE SET UP FROM LEFT TO RIGHT ON 1, 2, 5, 10, 15, AND 20 MC. ANY GIVEN MARKER IS ENERGIZED AND APPEARS AT THE PIP OUTPUT TERMINALS WHEN THE CORRESPONDING SWITCH IS IN THE ON POSITION.

10. SWEEP OUTPUT TERMINALS (J-2). A SAWTOOTH SWEEP VOLTAGE FOR THE HORIZONTAL DEFLECTION CIRCUITS OF THE OSCILLOSCOPE IS AVAILABLE AT THESE GR TERMINALS.

11. PIP OUTPUT TERMINALS (J-3). THESE GR TERMINALS BRING OUT THE FIXED AND VARIABLE MARKER PIPS. THEY ARE NORMALLY FED DIRECTLY TO VERTICAL (Y-AXIS) TERMINALS OF THE OSCILLOSCOPE.

12. EXTERNAL OSCILLATOR INPUT CONNECTOR (J-4). WHEN A CONTINUOUSLY VARIABLE FREQUENCY MARKER OUTPUT IS REQUIRED, THE OUTPUT OF A 50 KC TO 20-MC EXTERNAL OSCILLATOR IS CONNECTED DIRECTLY TO THIS UG-185/U BNC CONNECTOR.

13. SWEEPING OSCILLATOR OUTPUT CONNECTOR (J-5). SWEEPING FREQUENCY OUTPUT IS SUPPLIED TO THE VIDEO AMPLIFIER OR CIRCUIT UNDER TEST FROM THIS BNC CONNECTOR. THE OUTPUT AMPLITUDE VARIES FROM ZERO TO 0.3 VOLTS (INTO 70 OHMS), ACCORDING TO THE SETTINGS OF THE ADJACENT ATTENUATOR CONTROLS.

B. OPERATION.

IT IS ASSUMED THAT THE **model video** HAS BEEN CONNECTED TO THE CIRCUIT UNDER TEST, THE OSCILLOSCOPE, AND THE EXTERNAL MARKER OSCILLATOR (IF USED). IN ACCORDANCE WITH THE INSTRUCTIONS CONTAINED IN SECTION II, INSTALLATION.

1. PLUG THE POWER CORD INTO A 117-VOLT, 60 CYCLE OUTLET. PLACE ON-OFF SWITCH IN THE ON POSITION. ALLOW 10 TO 15 MINUTES WARM-UP PERIOD; THEN THROW ON-STANDBY SWITCH TO ON POSITION.

2. ADJUST THE OSCILLOSCOPE HORIZONTAL GAIN CONTROL FOR CORRECT HORIZONTAL TRACE LENGTH. (ENDS OF TRACE SHOULD BE VISIBLE.)

3. SET THE SWEEP WIDTH SELECTOR SWITCH, S-1, TO THE DESIRED VALUE.

4. ADJUST THE *SCOPE VERTICAL GAIN CONTROL AND THE ATTENUATOR CONTROLS ON THE **model video** FOR A RESPONSE ON THE *SCOPE SCREEN.

NOTE

The base line also will remain on the screen for use as a reference zero level.

5. ADJUST THE SWEEP RATE CONTROL, R-10, FOR A STATIONARY PATTERN.

6. IF MARKERS ARE DESIRED, ENERGIZE THE SELECTED MARKERS BY THROWING THE CORRESPONDING CRYSTAL MARKERS SWITCHES TO THE UPPER POSITION.

7. ADJUST PIP INCREASE R-97 FOR MARKER PIPS OF DESIRED HEIGHT.

8. ROTATE THE PIP ADJUST CONTROL FOR A FULL, STATIONARY COMPLEMENT OF MARKERS.

9. ADJUST THE CENTERING CONTROL SO THAT THE LEFT EDGE OF THE *SCOPE PATTERN, INDICATING ZERO FREQUENCY OUTPUT, IS SET AT THE START (LEFT END) OF THE *SCOPE TRACE.

10. IF AN EXTERNAL OSCILLATOR IS USED TO PROVIDE A VARIABLE MARKER PIP, SET THE EXTERNAL OSCILLATOR'S FREQUENCY TO THE DESIRED MARKER FREQUENCY. THE LOCATION OF THE MARKER WILL CORRESPOND TO THE FREQUENCY SETTING OF THE EXTERNAL OSCILLATOR.

SECTION IV THEORY OF OPERATION

A. GENERAL.

THE OPERATION OF THE **model video MARKA-SWEEP** MAY BE MORE READILY COMPREHENDED BY REFERRING TO THE FUNCTIONAL BLOCK DIAGRAM (figure 4) AND THE R-F CIRCUITRY SCHEMATIC (figure 7). THE EQUIPMENT IS COMPRISED OF THREE MAJOR CIRCUIT SEC-

TIONS. THESE ARE: SAWTOOTH CIRCUITS, SWEEPING FREQUENCY GENERATING CIRCUITS, AND MARKER PULSE CIRCUITS. IN ADDITION, A REGULATED POWER SUPPLY PROVIDES ALL OPERATING POTENTIALS FOR THE UNIT.

THE SWEEP VOLTAGE GENERATING CIRCUITS SUPPLY A 60-CYCLE SAWTOOTH VOLTAGE WHICH IS USED BOTH TO SWEEP THE FREQUENCY GENERATING OSCILLATOR AND FEED

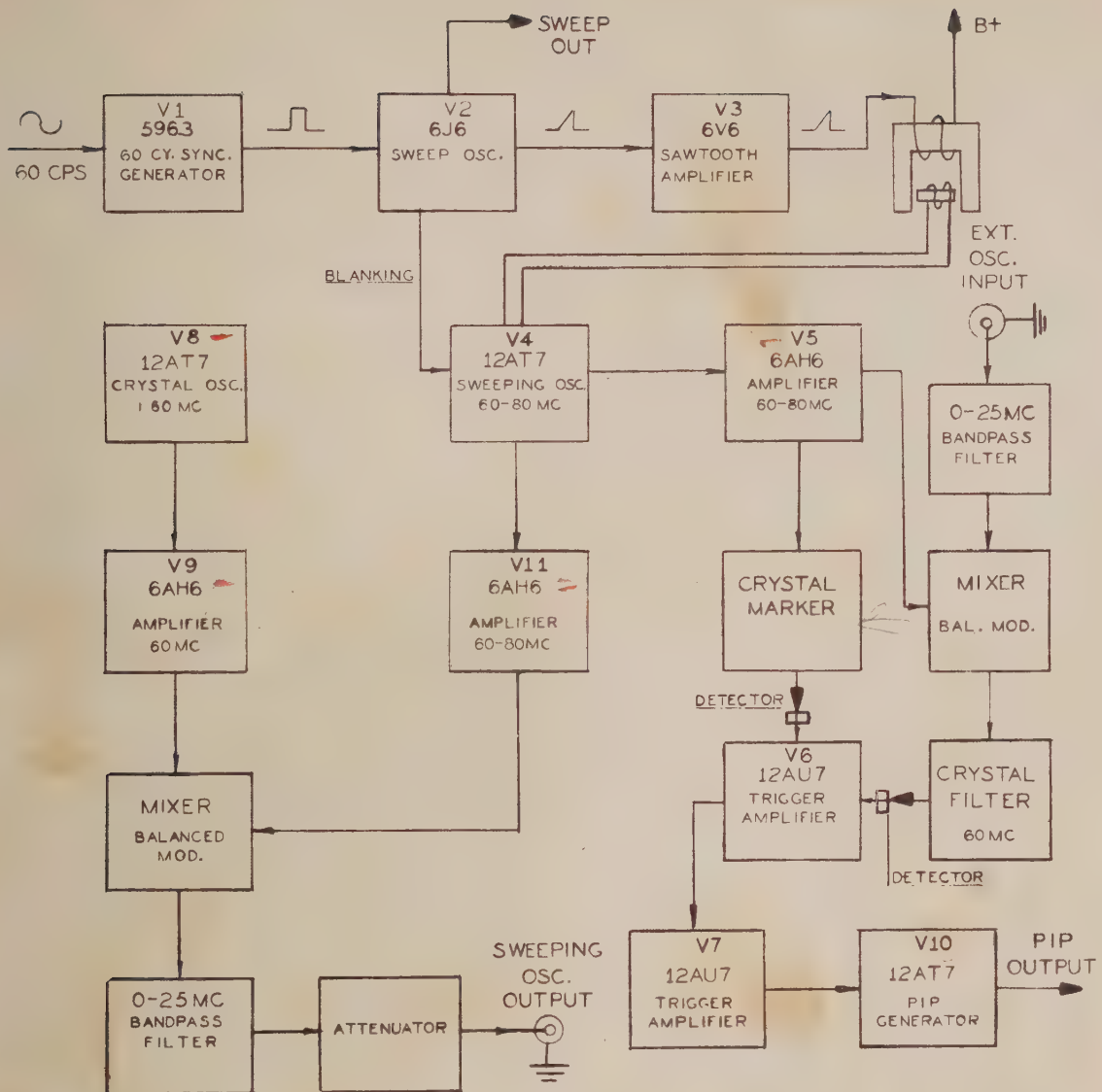


Figure 4. Functional Block Diagram

~~SWEPT THE FREQUENCY GENERATING OSCILLATOR AND FEED~~
A DEFLECTION VOLTAGE TO THE HORIZONTAL (X AXIS)
OF THE OSCILLOSCOPE.

THE SWEEPING FREQUENCY GENERATING CIRCUIT SUP-
PLIES THE ACTUAL SWEEPING FREQUENCY SIGNAL THAT
IS FED THROUGH THE CIRCUIT UNDER TEST. THE OUTPUT
VOLTAGE OF THE TESTED CIRCUIT IS THEN FED TO THE
VERTICAL (Y AXIS) OF THE OSCILLOSCOPE FOR DISPLAY.
SINCE THE MAGNITUDE OF THE VOLTAGE INPUT TO THE
CIRCUIT UNDERGOING TEST IS CONSTANT THROUGHOUT ITS
ENTIRE SWEEP, THE RESPONSE CHARACTERISTICS OF THE
TEST CIRCUIT WILL BE GRAPHICALLY DISPLAYED ON THE
OSCILLOSCOPE SCREEN.

SIX FIXED MARKERS FOR FREQUENCY IDENTIFICATION
OF VARIOUS POINTS ALONG THE SCOPE TRACE ARE GENER-

ATED BY THE INTEGRAL MARKER PULSE CIRCUITS. THESE
MARKERS ARE DERIVED FROM A SERIES OF CRYSTAL-FILTER,
ABSORPTION-TYPE CIRCUITS. TO PROVIDE FOR A VARIA-
BLE FREQUENCY MARKER, A SPECIAL CIRCUIT IS INCLUDED
WHICH WILL UTILIZE THE OUTPUT OF AN EXTERNAL MARKER
GENERATOR TO GENERATE A MARKER WHICH IS CONTINU-
OUSLY VARIABLE OVER THE OPERATING RANGE OF THE
model video.

B. DETAILED CIRCUIT DESCRIPTION.

1. SWEEP CIRCUITS.

a. SYNC GENERATOR (V-1). THIS STAGE EM-
PLOYS A 5963 DUAL TRIODE TO GENERATE A NEG-
ATIVE SYNC PULSE FOR LOCKING THE SAWTOOTH
GENERATOR (V-2) TO THE POWER LINE FREQUENCY.

A SMALL 60-CPS VOLTAGE FROM THE HEATER SUPPLY IS COUPLED TO THE GRID OF $V-1$ THROUGH $C-2$. NEGATIVE OUTPUT PULSES ARE COUPLED TO THE SUCCEEDING SQUARE WAVE GENERATOR THROUGH CAPACITOR $C-3$.

2. SQUARE WAVE GENERATOR ($V-2$). THIS 6J6 SQUARE WAVE GENERATOR IS ESSENTIALLY A FREE RUNNING MULTIVIBRATOR WHOSE REPETITION RATE IS DETERMINED BOTH BY THE SETTING OF THE SWEEP RATE POTENTIOMETER ($R-10$) AND THE OPERATION OF THE PRECEDING SYNC GENERATOR. TO PROVIDE A CLEAR, ZERO-VOLTAGE REFERENCE LINE, THE SQUARE WAVE OUTPUT IS FED TO THE GRID OF THE SWEEPING OSCILLATOR ($V-4$), DISABLING IT DURING THE NEGATIVE PORTION OF THE SQUARE WAVE GENERATOR'S OUTPUT. THE SQUARE WAVE ALSO IS FED INTO AN INTEGRATING NETWORK WHICH SHAPES IT TO A REGULAR SAWTOOTH. THIS VOLTAGE IS THEN FED BOTH TO THE SAWTOOTH AMPLIFIER ($V-3$) AND TO THE SWEEP OUTPUT TERMINALS WHERE IT IS USED AS A HORIZONTAL DEFLECTION SIGNAL FOR THE OSCILLOSCOPE.

C. SWEEPING OSCILLATOR CIRCUITS.

THESE CIRCUITS UTILIZE SATURABLE REACTOR TECHNIQUES TO GENERATE A LINEAR SWEEPING VOLTAGE, SYNCHRONIZED TO THE SAWTOOTH SWEEP OUTPUT VOLTAGE. THE CIRCUITRY INCLUDES A SAWTOOTH AMPLIFIER ($V-3$) AND A SWEEPING OSCILLATOR WHOSE OUTPUT IS USED BOTH AS A SWEEPING FREQUENCY FOR THE CIRCUITS UNDER TEST AND TO SYNTHESIZE THE VARIABLE AND FIXED MARKERS.

1. SAWTOOTH AMPLIFIER ($V-3$). THIS STAGE EMPLOYS A 6V6 PENTODE TO PROVIDE LINEAR AMPLIFICATION OF THE 60-CPS SIGNAL PRODUCED BY THE SHAPING NETWORK. THE PLATE LEAD FOR THIS TUBE INCLUDES THE CONTROL WINDING OF A SATURABLE REACTOR IN THE PLATE CIRCUIT OF THE SWEEPING OSCILLATOR. AS THE PLATE CURRENT OF $V-3$ VARIES, IT CAUSES A CORRESPONDING VARIATION IN THE INDUCTANCE OF THE SATURABLE REACTOR SECONDARY AND THUS IN THE OUTPUT FREQUENCY OF THE SWEEPING OSCILLATOR. THE SETTINGS OF THE SWEEP WIDTH SWITCH ($S-1$) AND THE INTERNAL SWEEP WIDTH POTENTIOMETER ($R-21$) CONTROL THE AMPLITUDE OF THE SAWTOOTH VOLTAGE APPLIED TO THE GRID OF $V-3$ AND THUS THE DURATION (WIDTH) OF THE SWEEPING OUTPUT AT $V-4$.

2. SWEEPING OSCILLATOR ($V-4$). THIS STAGE UTILIZES A 12AT7 DUAL TRIODE IN A SATURABLE REACTOR CIRCUIT TO GENERATE A SWEEPING OUTPUT IN THE 60-80 MC RANGE. THIS BAND OF FREQUENCIES IS THEN HETERODYNED IN A BALANCED MODULATOR AGAINST THE 60-MC OUTPUT OF THE CRYSTAL-CONTROLLED "LOCAL" OSCILLATOR ($V-8$) TO PRODUCE THE FINAL 0.5, 0.10, OR 0.20 MC DIFFERENCE FREQUENCY OUTPUT.

THE FREQUENCY OF THE OSCILLATOR AT ANY TIME IS DETERMINED BY THE EFFECTIVE INDUCTANCE OF THE SATURABLE REACTOR SECONDARY CORE, $L-2$. THE PERMEABILITY OF THE CORE, IN TURN, VARIES WITH THE MAGNITUDE OF PLATE CURRENT, FROM THE SAWTOOTH AMPLIFIER $V-3$ WHICH SATURATES THE CONTROL WINDING $L-1$. THE WIDTH OF THE SWEEPING SIGNAL IS THUS DETERMINED BY THE AMPLITUDE OF THE SIGNAL APPEARING ON THE GRID OF THE SAWTOOTH AMPLIFIER.

TO PROVIDE A CLEAR, ZERO-VOLTAGE REFERENCE LINE ON THE 'SCOPE, A NEGATIVE BLANKING VOLTAGE FROM THE SQUARE WAVE GENERATOR IS FED TO THE GRIDS OF THE SWEEPING OSCILLATOR TO DISABLE IT DURING ALTERNATE (NEGATIVE) HALF-CYCLES OF OPERATION. THE SWEEPING OUTPUT OF $V-4$ IS FED BOTH TO $V-11$ IN THE BALANCED MODULATOR CIRCUITS AND VIA $V-5$ TO THE FIXED AND VARIABLE MARKER CIRCUITS.

3. R-F OUTPUT CIRCUITS. THESE CIRCUITS CONVERT THE 60-80 MC OUTPUT OF THE SWEEPING OSCILLATOR TO A FREQUENCY IN THE 50-KC TO 20-MC RANGE. THIS DIFFERENCE FREQUENCY IS THEN FED THRU A SERIES OF STEP AND VARIABLE ATTENUATORS TO THE CIRCUIT UNDER TEST.

a. BUFFER AMPLIFIER ($V-11$). THIS TUBE, A 6AH6 SHARP CUT-OFF PENTODE, PROVIDES A SINGLE STAGE OF AMPLIFICATION AND ISOLATION FOR THE OUTPUT OF THE SWEEPING OSCILLATOR.

b. 60-MC CRYSTAL OSCILLATOR ($V-8$ AND $V-9$). THIS CIRCUIT COMPRISES A CATHODE-COUPLED, DUAL TRIODE, CRYSTAL OSCILLATOR AND A SINGLE-STAGE AMPLIFIER WHICH FUNCTION AS A BEAT-FREQUENCY OSCILLATOR FOR THE BALANCED MODULATOR. THE 60-MC OUTPUT OF THE 12AT7 OSCILLATOR STAGE IS INDUCTANCE-COUPLED TO THE GRID OF A 6AH6 BUFFER AMPLIFIER ($V-9$). THE OUTPUT OF THE AMPLIFIER STAGE, A STABLE 60-MC FREQUENCY, IS FED DIRECTLY INTO THE PRIMARY OF TRANSFORMER $T-3$ IN THE BALANCED MODULATOR #1.

c. BALANCED MODULATOR #1. THIS CIRCUIT IS COMPOSED OF FOUR TYPE CK-705 CRYSTAL DETECTORS CONNECTED ACROSS THE SECONDARIES OF TWO INPUT TRANSFORMERS. THE INPUT ACROSS $T-3$ IS A FIXED 60-MC SIGNAL FROM THE 60-MC CRYSTAL-CONTROLLED LOCAL OSCILLATOR. THE INPUT ACROSS $T-2$ WILL BE A 60-MC TO 80-MC SWEEPING FREQUENCY FROM $V-4$. AFTER MIXING AND MODULATION, A DIFFERENCE FREQUENCY IN THE 50-KC TO 20-MC RANGE IS FED OUT THROUGH A THREE-SECTION BAND-PASS FILTER TO THE FIXED AND VARIABLE ATTENUATOR.

d. OUTPUT CIRCUITS. THE OUTPUT OF THE ZERO TO 20-MC BANDPASS FILTER IS FED THRU A

SINGLE VARIABLE POTENTIOMETER AND FOUR FIXED SWITCHABLE ATTENUATORS TO THE FINAL SWEEPING OSCILLATOR OUTPUT JACK (J-5). THE VARIABLE INCREASE POTENTIOMETER (R-47a AND R-47b) PROVIDES A 6-DB RANGE OF AMPLITUDE CONTROL. THE FOUR FIXED ATTENUATORS, EACH CONTROLLED BY A SEPARATE SWITCH (S-9, S-10, S-11 AND S-12) PROVIDE ATTENUATION IN STEPS OF 20-DB, 20-DB, 10-DB AND 3-DB RESPECTIVELY.

D. MARKER PULSE CIRCUITS.

THE **model video** CONTAINS A FIXED MARKER PULSE CIRCUIT PROVIDING SIX CRYSTAL-CONTROLLED MARKER PULSES. IN ADDITION, A SPECIAL CIRCUIT EMPLOYING A BALANCED MODULATOR, A 30-MC CRYSTAL FILTER, AND A DIODE DETECTOR MAY BE USED IN CONJUNCTION WITH AN EXTERNAL OSCILLATOR TO GENERATE A CONTINUOUSLY VARIABLE FREQUENCY MARKER PULSE.

1. SWEEPING FREQUENCY AMPLIFIER (V-10). THIS STAGE, SIMILAR TO V-11, FUNCTIONS AS AN AMPLIFIER AND ISOLATION STAGE FOR THE MARKER PULSE CIRCUITS. THE 60-MC TO 80-MC OUTPUT SIGNAL FROM THE SWEEPING FREQUENCY OSCILLATOR IS FED TO THE GRID OF THE STAGE THROUGH R-36. THE AMPLIFIED SWEEPING OUTPUT SIGNAL (60-MC TO 80-MC) IS FED BOTH TO BALANCED MODULATOR #2 AND TO THE CRYSTAL MARKER CIRCUIT.

2. MARKER CRYSTAL. CRYSTALS Y-1 THROUGH Y-6 ARE EMPLOYED AS ABSORPTION-TYPE MARKERS. EACH CRYSTAL IS RESONANT AT A SINGLE FREQUENCY IN THE 60-MC TO 80-MC RANGE. AS THE FREQUENCY OF THE SWEEPING OSCILLATOR ADVANCES THROUGH A CRYSTAL FREQUENCY, A TRAIN OF OSCILLATIONS IS GENERATED BY THE CRYSTAL, RECTIFIED INTO A POSITIVE D-C PULSE BY D-2 AND FED TO THE INPUT

OF THE FIRST TRIGGER AMPLIFIER STAGE (V-6).

3. FIRST TRIGGER AMPLIFIER (V-6). THIS STAGE EMPLOYS A 12AU7 DUAL TRIODE, TO PROVIDE TWO STAGES OF AMPLIFICATION FOR THE TRIGGER PULSES FROM THE CRYSTAL MARKERS (AND THE VARIABLE FREQUENCY MARKERS DESCRIBED LATER IN THIS SECTION). THE OUTPUT PULSES ARE FED TO THE PIP ADJUST POTENTIOMETER, R-63.

4. SECOND TRIGGER AMPLIFIER (V-13). THIS STAGE PROVIDES AN ADDITIONAL TWO STAGES OF AMPLIFICATION FOR THE MARKER TRIGGER PULSES BEFORE FEEDING THEM TO THE PIP GENERATOR MULTIVIBRATOR (V-14).

5. PIP GENERATOR (V-13). THIS STAGE IS A ONE-SHOT MULTIVIBRATOR EMPLOYING A 12AU7 DUAL TRIODE. POSITIVE TRIGGER PULSES FROM THE SECOND TRIGGER AMPLIFIER ARE SUPPLIED TO V-10; EACH TRIGGER PULSE CAUSES THE MULTIVIBRATOR TO PRODUCE ONE POSITIVE MARKER PULSE. THE OUTPUT POSITIVE MARKER PULSE IS FED TO R-97, THE MARKER INCREASE CONTROL, AND THE PIP OUTPUT (J-3) TERMINALS.

6. VARIABLE MARKER PULSE CIRCUIT. A VARIABLE ZERO TO 20-MC SIGNAL FROM AN EXTERNAL OSCILLATOR IS FED TO BALANCED MODULATOR #2 WHERE IT IS MIXED WITH THE 60-MC TO 80-MC SWEEPING FREQUENCY FROM V-10. THE RESULTANT DIFFERENCE SWEEPING FREQUENCY IS FED INTO A CRYSTAL FILTER Y-8, RESONANT AT 60 MC. AS THE DIFFERENCE FREQUENCY SIGNAL IS SWEEPED PAST 60 MC, AN R-F PULSE IS PRODUCED. THIS PULSE IS RECTIFIED BY D-7. THE VARIABLE FREQUENCY PULSE IS THEREAFTER PASSED ON TO THE PIP GENERATOR MULTIVIBRATOR IN THE SAME MANNER AS THE FIXED FREQUENCY PULSES DESCRIBED PREVIOUSLY.

SECTION V MAINTENANCE

A. TROUBLE LOCATION

IF THE OPERATION OF THE **model video** MARKA-SWEEP APPEARS TO BE DEFECTIVE IN ANY RESPECT, FIRST ASCERTAIN THAT THE CAUSE OF IMPROPER OPERATION IS NOT IN THE OSCILLOSCOPE, THE CIRCUIT UNDER TEST, OR THE INTERCONNECTING CABLES. IF A PROCESS OF ELIMINATION INDICATES THAT THE TROUBLE ORIGINATES IN THE **model video**, MAKE THE FOLLOWING PRELIMINARY CHECKS:

1. CHECK THE OPERATION OF ALL THE EQUIPMENT CIRCUITS TO DETERMINE THE EXACT NATURE AND EXTENT OF THE DEFECT.

2. MAKE A VISUAL CHECK TO DETERMINE THAT ALL FILAMENTS ARE LIT AND THAT THERE ARE NO LOOSE

CONNECTIONS OR OBVIOUSLY DAMAGED COMPONENTS.

3. CHECK THE VOLTAGE LEVEL AT THE A-C LINE, THE B+ INPUT, AND ALL CHASSIS TEST POINTS.

THE MOST COMMON TROUBLES ENCOUNTERED WITH THE **model video** ARE WEAK OR DEFECTIVE TUBES, CRYSTAL DIODE FAILURES, AND OCCASIONAL MISALIGNMENTS. THE TROUBLE-LOCATION CHART, TABLE I, MAY BE USED AS A GUIDE TO ISOLATE THE TROUBLE TO A PARTICULAR CIRCUIT. Figure 7, A COMPLETE SCHEMATIC OF THE FREQUENCY GENERATING CIRCUITS, INDICATES THE NORMAL VOLTAGE MEASUREMENTS AT SIGNIFICANT POINTS IN THE CIRCUITRY. THE PHYSICAL LOCATION OF ALL TUBES, POTENTIOMETERS, SWITCHES AND OTHER MAJOR COMPONENTS IS INDICATED ON figures 6 AND 7 THE COMPONENT

SYMPTOM	PROBABLE CAUSE AND CORRECTION
1. LOSS OF HORIZONTAL DEFLECTION ON 'SCOPE.	CHECK SAWTOOTH GENERATING CIRCUITS. (V-1, V-2): CHECK POWER SUPPLY.
2. UNSTABLE TRACE ON 'SCOPE.	CHECK SYNC GENERATOR (V-1): SQUARE WAVE GENERATOR (V-2): ADJUSTMENT OF R-8.
3. LOSS OF VERTICAL DEFLECTION ON 'SCOPE.	CHECK SWEEPING OSCILLATOR (V-4). CRYSTAL OSCILLATOR (V-8): ALSO V-9, V-11, AND DIODES D-8, D-9, D-10, AND D-11.
4. LOSS OF ONE CRYSTAL MARKER: ALL OTHER MARKERS O.K.	CHECK CRYSTAL IN FAULTY MARKER CIRCUIT: CHECK ASSOCIATED COMPONENTS IN CRYSTAL CIRCUIT.
5. LOSS OF ALL CRYSTAL MARKERS: VARIABLE MARKER O.K.	CHECK RECTIFIER, D-2, IN DETECTOR CIRCUIT.
6. LOSS OF ALL MARKERS.	CHECK TRIGGER AMPLIFIERS, V-6 AND V-7, ALSO CHECK PIP GENERATOR, V-10: CHECK ADJUSTMENT OF R-95 AND R-63, THE PIP ADJUST CONTROL.
7. LOSS OF VARIABLE MARKERS: FIXED MARKERS O.K.	CHECK DIODES IN BALANCED MODULATOR, D-3, D-4, D-5 AND D-6. CHECK CRYSTAL Y-8: CHECK DETECTOR, D-7.

LOCATION DIAGRAMS. A COMPLETE SCHEMATIC OF THE REGULATED POWER SUPPLY **Model 200A**, USED WITH THE **model video** IS SHOWN IN THE ADDENDUM AT THE END OF THE BOOK.

B. ALIGNMENT AND ADJUSTMENT.

1. SYNC LOCK CONTROL (R-8). THE SETTING OF THIS CHASSIS CONTROL DETERMINES THE AMPLITUDE OF THE 60-CYCLE SYNC PULSE FED TO THE SYNC GENERATOR.

a. WITH THE EQUIPMENT SET UP AS SHOWN IN *figure 5*, ROTATE THE SYNC LOCK CONTROL (R-8) UNTIL THE 'SCOPE PATTERN APPEARS TO "LOCK-IN" WITH THE POWER LINE FREQUENCY OVER A MINIMUM ROTATION OF THE SWEEP RATE GENERATOR.

b. SET THE SWEEP RATE CONTROL (R-10) TO THE MID-POSITION OF THE "LOCK-IN" REGION.

c. READJUST THE SYNC LOCK CONTROL (R-8) FOR A STATIONARY 'SCOPE DISPLAY.

2. SWEEP WIDTH CONTROL (R-21). THE SWEEP WIDTH CONTROL SHOULD BE ADJUSTED IN THE FOLLOWING MANNER.

a. SET THE SWEEP SELECTOR, S-1, TO 0-20 MC POSITION.

b. THROW THE 20-MC MARKER SWITCH TO THE

UPPER POSITION.

c. WITH THE SWEEPING OSCILLATOR OUTPUT JACK CONNECTED VIA A DETECTOR TO THE VERTICAL (Y-AXIS) INPUT OF THE OSCILLOSCOPE (SEE *figure 5*), ADJUST R-21 FOR A SCOPE TRACE LENGTH TO INCLUDE THE 20-MC MARKER: i.e., ABOUT 22 MC.

d. AFTER ADJUSTING R-21, ROTATE S-1 TO THE 0-10 POSITION. THE 10-MC MARKER SHOULD BE JUST INSIDE THE RIGHT END OF THE TRACE. SIMILARLY, ON THE ZERO TO 5-MC SWEEP WIDTH, THE 5-MC MARKER SHOULD APPEAR.

3. FREQUENCY CENTERING CAPACITORS (C-18, C-19 AND C-20). THE FREQUENCY CENTERING CAPACITORS PERMIT THE ALIGNMENT OF THE SWEEP TRACE FOR EACH POSITION OF THE SWEEP SELECTOR SWITCH (S-1).

a. WITH EQUIPMENT SET UP AS SHOWN IN *figure 5*, THE SWEEP SELECTOR SWITCH SET FOR ZERO TO 20 MC, AND THE CENTERING CONTROL (R-26) SET IN MID-POSITION, ADJUST C-18 SO THAT THE START (LEFT END) OF THE TRACE IS ALIGNED WITH THE ZERO FREQUENCY OUTPUT INDICATION (DOWNWARD PIP) ON THE 'SCOPE.

b. ROTATE THE SWEEP SELECTOR TO THE ZERO TO 10-MC POSITION AND REPEAT ABOVE PROCEDURE

ADJUSTING C-19; ROTATE THE SWEEP SELECTOR TO ZERO TO 5-MC POSITION AND REPEAT PROCEDURE ONCE MORE, ADJUSTING C-20.

C. IT SHOULD BE NOTED THAT THE FREQUENCY OF THE SWEEPING OSCILLATOR ALSO IS DETERMINED BY L-3. THE TURNS OF L-3 MAY BE OPENED OR CLOSED SLIGHTLY WHEN NECESSARY.

4. RF OUTPUT CIRCUIT ALIGNMENT. USE THE FOLLOWING PROCEDURE AS A GUIDE IN ALIGNING THE LOCAL OSCILLATOR AND MODULATOR CIRCUITS.

a. SET UP THE **model video** WITH THE SWEEP OUTPUT CONNECTED DIRECTLY TO A DETECTOR (SEE *figure 5*). THE DETECTOR OUTPUT SHOULD BE CONNECTED TO THE VERTICAL (Y AXIS) INPUT OF THE OSCILLOSCOPE.

b. SET SWEEP WIDTH TO ZERO TO 20-MC.

C. ADJUST SWEEPING OSC. OUTPUT CONTROLS SO THAT THE SWEEPING TRACE IS IN THE NORMAL OPERATING POSITION ON THE 'SCOPE SCREEN. AVOID A LOCATION ON THE SCREEN WHERE THE TRACE MAY BECOME DISTORTED BY THE CR TUBE.

d. IF THE SWEEPING OUTPUT IS NOT FLAT AND PARALLEL TO THE REFERENCE LINE, MAKE THE ADJUSTMENTS IN TABLE 2.

TABLE NO. 2.

STEP	COMPONENT	ADJUSTMENT
1	T-2 AND T-3	ADJUST FOR STRAIGHT LINE PARALLEL TO REFERENCE LINE.
2	L-15	ADJUST FOR STRAIGHT LINE PARALLEL TO REFERENCE LINE.
3	C-77	ADJUST TO MINIMIZE SMALL IMPERFECTIONS.
4	T-1	TUNE FOR RESONANCE (MAXIMUM VERTICAL DEFLECTION).
5	C-75	ADJUST FOR RATED OUTPUT. (DO NOT ADVANCE BEYOND POINT WHERE TRACE BECOMES DISTORTED OR "BIRDIE" BEAT PRODUCTS BECOME EXAGGERATED.)

5. CRYSTAL MARKER CIRCUIT ALIGNMENT.

a. SET THE **model video** UP WITH THE SWEEP OUTPUT CONNECTED IN THE NORMAL MANNER; HOWEVER, CONNECT THE VERTICAL INPUT OF THE OSCILLOSCOPE TO PIN 7 OF V-7 AND GROUND. SET SWEEP WIDTH TO ZERO TO 20-MC.

b. THROW ALL MARKER SWITCHES TO THE UPPER POSITION.

C. ROTATE THE PIP ADJUST (R-63) CONTROL COUNTER-CLOCKWISE UNTIL MARKERS ARE VISIBLE ON 'SCOPE. (FOR THIS ADJUSTMENT, IT IS NECESSARY TO SET R-63 TO A LEVEL BELOW SATURATION OF THE TRIGGER AMPLIFIER; RETURN R-63 TO NORMAL POSITION AFTER ADJUSTING

MARKERS.)

d. ADJUST L-4 THROUGH L-9 TO MAXIMIZE AND EQUALIZE THE AMPLITUDE OF ALL SIX PULSES APPEARING ON THE 'SCOPE.

6. VARIABLE MARKER CIRCUIT ALIGNMENT.

a. SET THE **model video** UP WITH THE SWEEP OUTPUT CONNECTED IN THE NORMAL MANNER; HOWEVER, CONNECT THE VERTICAL INPUT OF THE OSCILLATOR TO PIN 7 OF V-7 AND GROUND. SET SWEEP WIDTH TO ZERO TO 20-MC.

b. FEED THE OUTPUT OF AN EXTERNAL SIGNAL GENERATOR INTO THE EXTERNAL OSCILLATOR INPUT CONNECTOR. SET EXTERNAL OSCILLATOR FOR 17 MC, APPROXIMATELY 0.1 VOLT OUTPUT. A PULSE SHOULD APPEAR AT 17 MC ON THE 'SCOPE.

C. ADJUST C-30 AND C-36 FOR MAXIMUM PULSE LEVEL ON 'SCOPE.

d. ADJUST L-13 SO THAT PULSE LEVEL IS EQUAL TO FIXED MARKER PULSES OBTAINED IN PARAGRAPH B-5D ABOVE.

e. AS A FINAL TEST, VARY THE EXTERNAL OSCILLATOR FREQUENCY BETWEEN 50 KC AND 20 MC. THE VERTICAL LEVEL OF THE PULSES SHOULD REMAIN CONSTANT.

7. INTERNAL PIP ADJUST CONTROL (R-94). THE INTERNAL PIP ADJUST CONTROL SHOULD BE ADJUSTED AS FOLLOWS: CONNECT THE **model video** AS SHOWN IN *figure 5*; SEE *figure 7* FOR LOCATION OF R-94.

a. SET THE SWEEP SELECTOR, S-1 TO ZERO TO 20-MC POSITION.

b. THROW ALL MARKER SWITCHES TO THE OFF (LOWER) POSITION.

C. ROTATE THE FRONT PANEL PIP INCREASE CONTROL FULLY CLOCKWISE.

d. ADJUST R-94 TO THE POINT WHERE THE PIP GENERATOR STAGE BEGINS TO RUN FREELY (I.E., OUT OF SYNC, RANDOM PIPS APPEAR ON THE 'SCOPE SCREEN).

e. ROTATE THE FRONT PANEL PIP INCREASE CONTROL COUNTER-CLOCKWISE SO THAT PIPS MAY BE CLEARLY SEEN ON THE 'SCOPE.

f. BACK OFF ADJUSTMENT OF R-94 UNTIL FREE RUNNING PIPS DISAPPEAR.

g. THROW ALL MARKER SWITCHES TO THE UPPER POSITION; ROTATE THE FRONT PANEL PIP ADJUST CONTROL UNTIL ALL SIX MARKERS APPEAR ON 'SCOPE TRACE.

h. MAKE A SLIGHT READJUSTMENT OF R-94 TO REACH A POINT WHICH AFFORDS THE GREATEST AMOUNT OF VARIATION OF THE FRONT PANEL PIP ADJUST CONTROL BETWEEN THE LIMITS OF DISAPPEARING PIPS AND MULTIPLE PIPS.

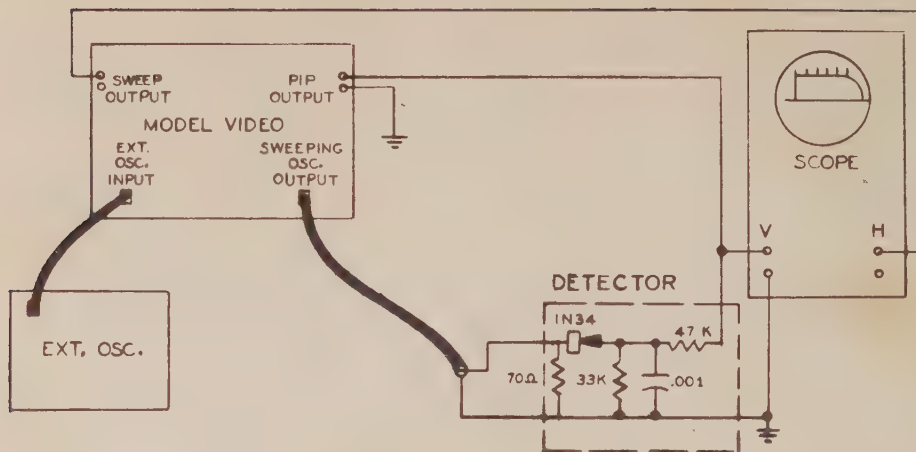
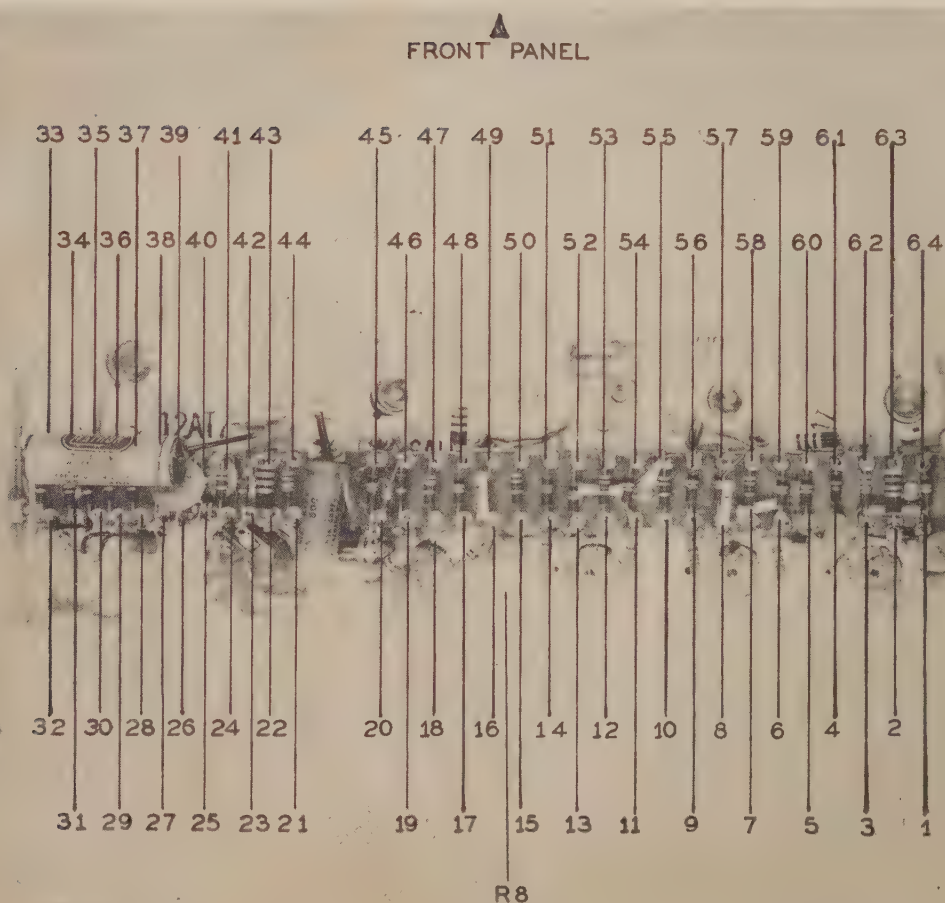


Figure 5. Alignment Set-up



NOTE-
REFER TO SCHEMATIC DIAGRAM FOR VOLTAGE AND RESISTANCE
MEASUREMENT AT THE ABOVE DESIGNATED TEST POINTS.

Figure 6. Terminal Board Voltage Measurements

Note: VALUES INDICATED BESIDE DOTTED LINES APPLY TO TEST POINTS FOR VOLTAGE & RESISTANCE MEASUREMENTS.
 ○ NUMBERS IN CIRCLES INDICATE TERMINAL BOARD TEST POINTS.

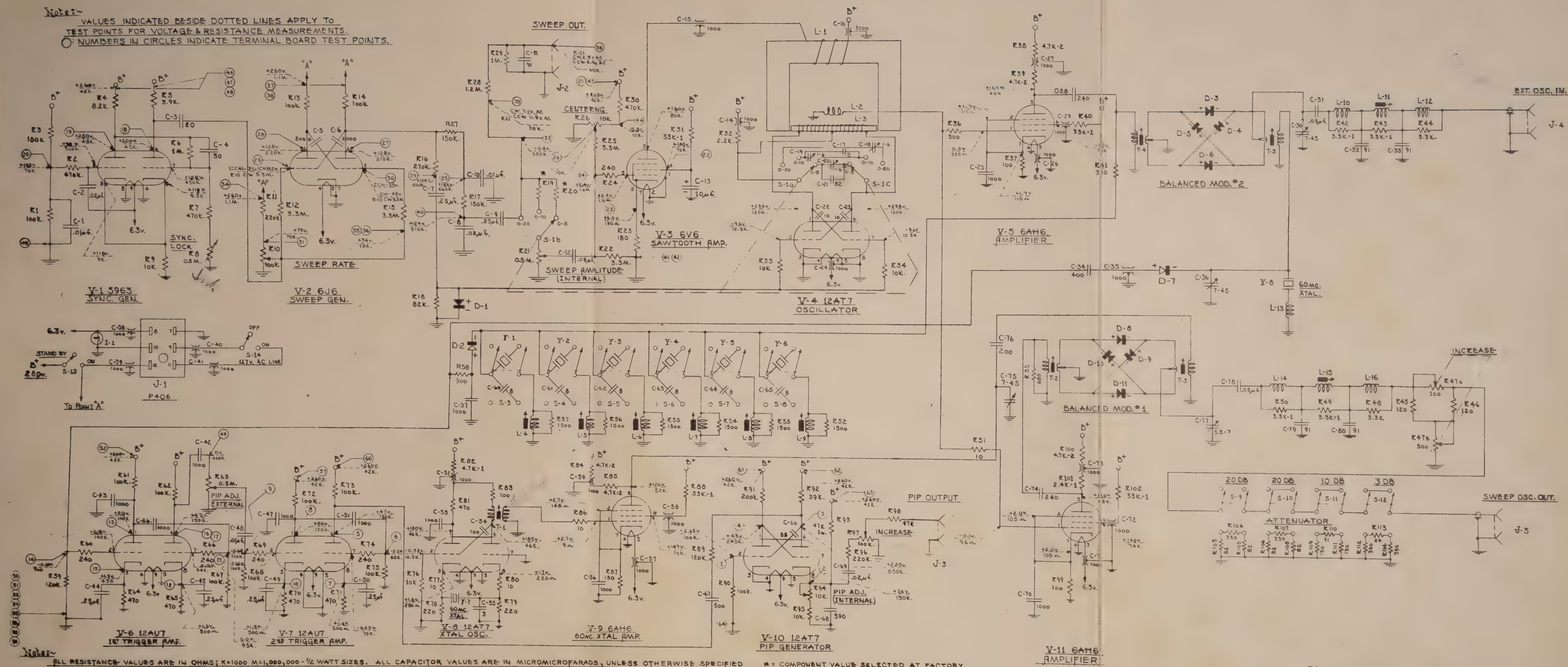


Figure 7, Schematic Diagram, R-f Circuit

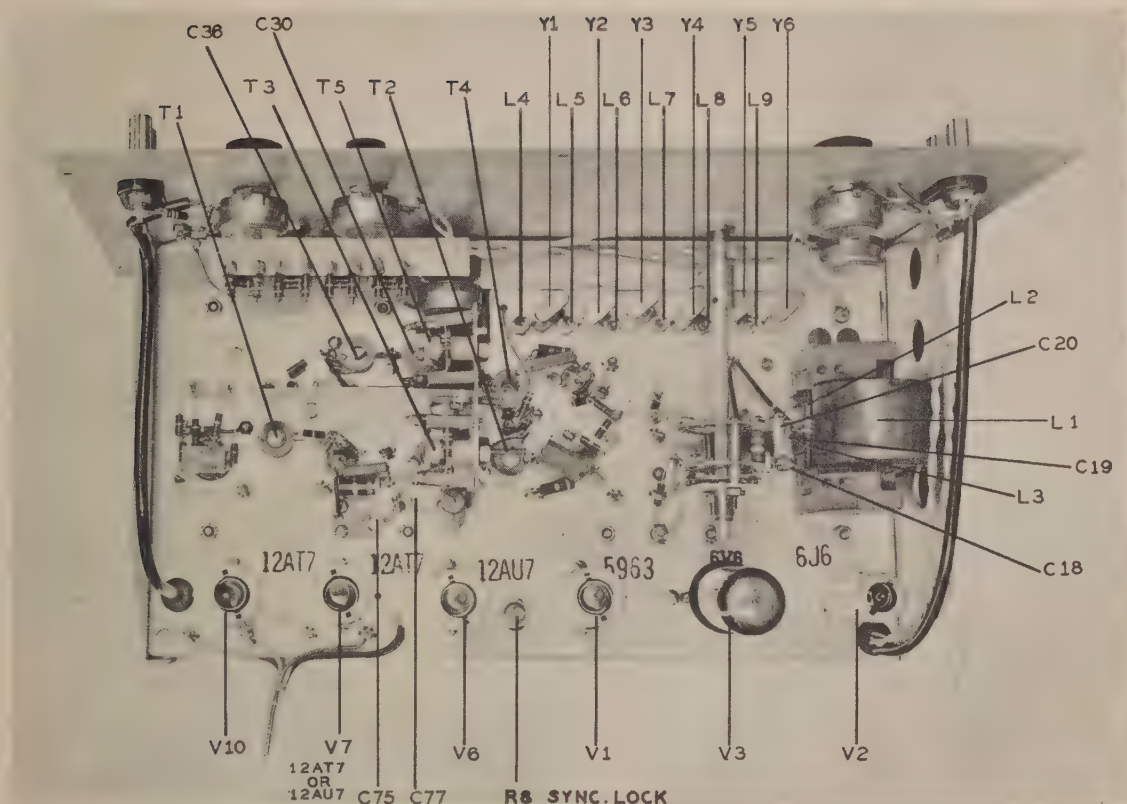


Figure 8. Component Location, Top of Chassis

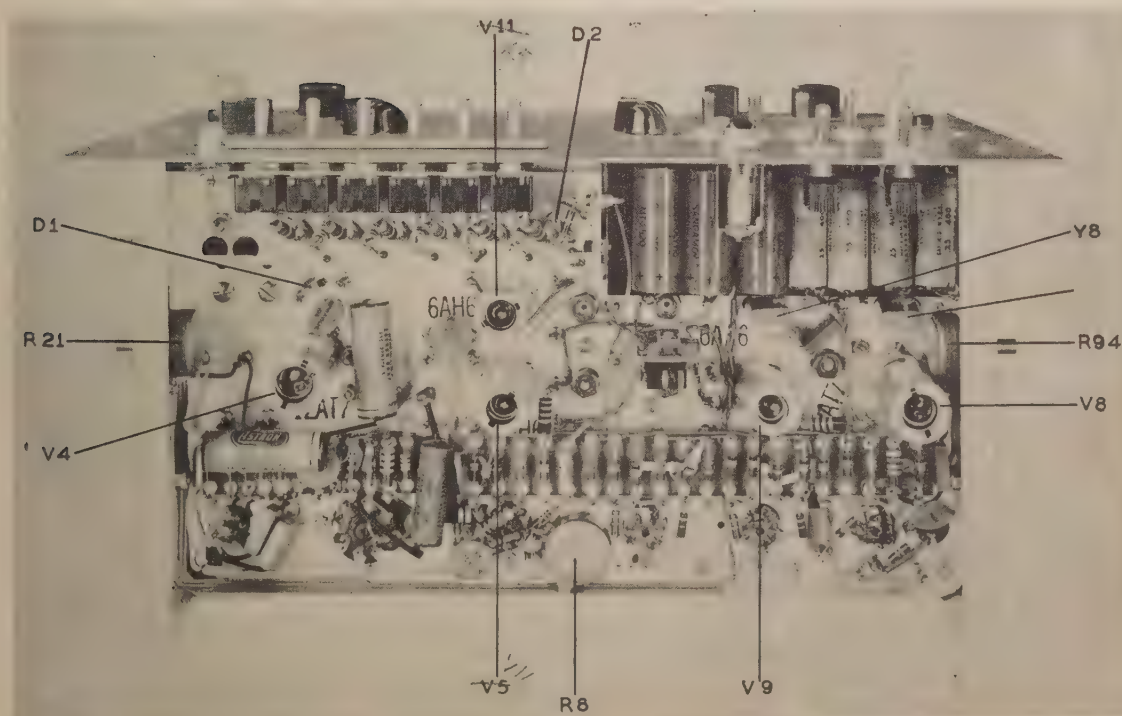


Figure 9. Component Location, Bottom of Chassis

SECTION VI

PARTS LIST

RESISTORS (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED, $\frac{1}{2}$ WATT, 10% TOLERANCE, COMPOSITION RESISTORS. ALL RESISTANCE VALUES STATED IN OHMS.)

R-1 100 K	R-40 33 K, 1 WATT	R-77 10
R-2 470 K	R-41 390	R-78 220
R-3 180	R-42 3.3 K, 1 WATT	R-79 220
R-4 8.2 K	R-43 3.3 K 1 WATT	R-80 10
R-5 3.9 K	R-44 3.3 K	R-81 470
R-6 1 M	R-45 120	R-82 4.7 K, 1 WATT
R-7 470 K	R-46 120	R-83 100
R-8 500 K, SYNC LOCK	R-47a 100, R-F INCREASE	R-84 4.7 K, 2 WATTS
R-9 10 K	R-47b 100, R-F INCREASE	R-85 4.7 K, 2 WATTS
R-10 100 K, SWEEP RATE	R-48 3.3 K	R-86 10
R-11 220 K	R-49 3.3 K, 1 WATT	R-87 150
R-12 3.3 M	R-50 3.3 K, 1 WATT	R-88 33 K, 1 WATT
R-13 100 K	R-51 10	R-89 120
R-14 100 K	R-52 1500	R-90 100 K
R-15 3.3 M	R-53 1500	R-91 200 K
R-16 270 K	R-54 1500	R-92 39 K
R-17 150 K	R-55 1500	R-93 47 K, 1 WATT
R-18 82 K	R-56 1500	R-94 10 K, PIP ADJ. (INTERNAL)
R-19 FACTORY SELECTED	R-57 1500	R-95 10 K
R-20 FACTORY SELECTED	R-58 300	R-96 220 K
R-21 500 K, SWEEP AMPL.	R-59 120 K	R-97 100 K, PIP INCREASE POT.
R-22 3.3 M	R-60 240	R-98 47 K
R-23 180	R-61 100 K	R-99 100
R-24 240	R-62 100 K	R-100 4.7 K, 2 WATTS
R-25 3.3 M	R-63 500 K, PIP ADJ	R-101 2.4 K, 1 WATT
R-26 10 K, CENTERING	R-64 470	R-102 33 K, 1 WATT
R-27 150 K	R-65 470	R-103 82
R-28 1.2 M	R-66 240	R-104 330
R-29 1 M	R-67 100 K	R-105 82
R-30 470 K	R-68 100 K	R-106 82
R-31 33 K, 1 WATT	R-69 240	R-107 330
R-32 2.2 K	R-70 470	R-108 82
R-33 10 K	R-71 470	R-109 130
R-34 10 K	R-72 100 K	R-110 91
R-35 680	R-73 100 K	R-111 130
R-36 300	R-74 240	R-112 390
R-37 100	R-75 100 K	R-113 24
R-38 4.7 K, 2 WATTS	R-76 10 K	R-114 390
R-39 4.7 K, 2 WATTS		R-115

COILS

L-1 PRIMARY
L-2 PICK-OFF LOOP
L-3 SECONDARY
L-4 SPECIAL SLUG-TUNED
L-5 SPECIAL SLUG-TUNED
L-6 SPECIAL SLUG-TUNED
L-7 SPECIAL SLUG-TUNED
L-8 SPECIAL SLUG-TUNED
L-9 SPECIAL SLUG-TUNED
L-10 SPECIAL
L-11 SPECIAL SLUG-TUNED
L-12 SPECIAL
L-13 SPECIAL
L-14 SPECIAL
L-15 SPECIAL SLUG-TUNED
L-16 SPECIAL

CONNECTORS

J-1 JONES PLUG, #P406, POWER CABLE
J-2 GENERAL RADIO, SWEEP OUTPUT
J-3 GENERAL RADIO, PIP OUTPUT
J-4 BNC, EXT. OSC. INPUT
J-5 BNC, SWEEPING OSC. OUTPUT

PILOT LAMP

I-1 6.3 VOLT, BAYONET TYPE, #44

CAPACITORS

C-1 ⁶ .01 μ F
C-2 .02 μ F
C-3 20
C-4 30
C-5 2000
C-6 2000
C-7 0025 μ F
C-8 0.25 μ F
C-9 0.25 μ F
C-10 0.01 μ F
C-11 91
C-12 .05 μ F
C-13 10 μ F, ELECTROLYTIC
C-14 1000, FEED THRU
C-15 1000, FEED THRU
C-16 1000, FEED THRU
C-17 5
C-18 1-6
C-19 1-6
C-20 1-6
C-21 82
C-22 10
C-23 10
C-24 1000, FEED THRU
C-25 1000
C-26 1000, FEED THRU
C-27 1000, FEED THRU

C-28 240
C-29 1000, FEED THRU
C-30 7-45, PADDER
C-31 .05 μ F
C-32 91
C-33 91
C-34 400
C-35 1000, FEED THRU
C-36 7-45, PADDER
C-37 1000
C-38 1000 FEED THRU
C-39 1000, FEED THRU
C-40 1000, FEED THRU
C-41 1000, FEED THRU
C-42 1000
C-43 1000
C-44 0.25 μ F
C-45 0.25 μ F
C-46 1000
C-47 1000
C-48 .01 μ F
C-49 0.25 μ F
C-50 0.25 μ F
C-51 1000
C-52 1000, FEED THRU
C-53 1000
C-54 100

C-55 3
C-56 1000
C-57 1000, FEED THRU
C-58 1000, FEED THRU
C-59 1000, FEED THRU
C-60 8
C-61 8
C-62 8
C-63 8
C-64 8
C-65 8
C-66 33
C-67 500
C-68 390
C-69 .02 μ F
C-70 1000
C-71 1000, FEED THRU
C-72 1000, FEED THRU
C-73 1000, FEED THRU
C-74 240
C-75 7-45, PADDER
C-76 200
C-77 1.5-7, PADDER
C-78 .05 μ F
C-79 91
C-80 91

TUBES

V-1 5963
V-2 6J6
V-3 6V6
V-4 12AT7
V-5 6AH6
V-6 12AU7
V-7 12AU7
V-8 12AT7
V-9 6AH6
V-10 12AT7
V-11 6AH6

DIODES

D-1 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-2 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-3 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-4 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-5 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-6 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-7 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-8 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-9 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-10 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE
D-11 CK-705A, SYLVANIA GERMANIUM CRYSTAL DIODE

CRYSTALS

Y-1 MARKERS
Y-2 MARKERS
Y-3 MARKERS
Y-4 MARKERS
Y-5 MARKERS
Y-6 MARKERS
Y-7 60 MC CRYSTAL, 5TH MODE
Y-8 60 MC CRYSTAL, 5TH MODE

SWITCHES

S-1A ROTARY, OAK TYPE, SWEEP SELECTOR
S-1B ROTARY, OAK TYPE, SWEEP SELECTOR
S-3 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-4 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-5 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-6 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-7 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-8 D.P.D.T., CRYSTAL ON-OFF SWITCH
S-9 D.P.D.T., ATTENUATOR SWITCH
S-10 D.P.D.T., ATTENUATOR SWITCH
S-11 D.P.D.T., ATTENUATOR SWITCH
S-12 D.P.D.T., ATTENUATOR SWITCH
S-13 S.P.S.T., STANDBY-ON SWITCH
S-14 S.P.S.T., ON-OFF AC LINE SWITCH

TRANSFORMERS

T-1 SPECIAL
T-2 SPECIAL
T-3 SPECIAL
T-4 SPECIAL
T-5 SPECIAL

A. DESCRIPTION.

POWER SUPPLY No. 200A IS A REGULATED D-C VOLTAGE SUPPLY WITH OUTPUT VOLTAGE ADJUSTABLE BETWEEN 225 AND 275 VOLTS. THE UNIT OPERATES FROM A 117V, 60-CPS POWER SOURCE. CONSTRUCTED ON AN INDIVIDUAL CHASSIS, THE SUPPLY IS A COMPLETELY SELF-CONTAINED UNIT DESIGNED FOR OPERATION IN CONJUNCTION WITH A TEST INSTRUMENT REQUIRING A HIGHLY STABLE D-C VOLTAGE SOURCE. THE SUPPLY IS NORMALLY ENCLOSED IN THE SAME CABINET AS THE ASSOCIATED R-F CIRCUITRY.

B. CIRCUIT DETAILS.

THIS REGULATED POWER SUPPLY FURNISHES ALL FILAMENT AND D-C POWER REQUIRED BY THE R-F CIRCUITS OF THE TEST EQUIPMENT.

1. RECTIFIER CIRCUIT. HIGH VOLTAGE IS SUPPLIED FROM THE SECONDARY OF $T-1$ TO THE CONVENTIONAL FULL WAVE RECTIFIER $V-1$, A 5U4G DUAL DIODE. THE RECTIFIED OUTPUT VOLTAGE IS FILTERED BY $C-1$, $L-1$ AND $C-2$ AND FED TO THE VOLTAGE REGULATOR CIRCUITS.

2. VOLTAGE REGULATOR CIRCUIT. THE FILTERED D-C VOLTAGE FROM $V-1$ IS FED THROUGH A REGULATING CIRCUIT COMPRISING $V-2$, $V-3$ AND $V-4$ TO THE OUTPUT TERMINAL. $V-2$, $V-3$ AND $V-4$ ARE EFFECTIVELY CONNECTED IN PARALLEL AND FUNCTION AS A VARIABLE SERIES RESISTANCE TO CONTROL THE OUTPUT VOLTAGE. THE REMAINING STAGES IN THE POWER SUPPLY ($V-5$, $V-6$, $V-7$) DETECT AND AMPLIFY ANY SIGNIFICANT OUTPUT VOLTAGE CHANGES AND FEED THEM TO THE CONTROL STAGE. THEY FUNCTION

IN THE FOLLOWING MANNER:

THE NEON-GLOW TUBES ($I-1$ AND $I-2$) IN THE $V-6$ CIRCUIT HAVE A NON-LINEAR CHARACTERISTIC WHICH CAUSES A SMALL INCREASE IN THE D-C OUTPUT VOLTAGE TO PRODUCE A RELATIVELY LARGE CHANGE AT THE GRID OF $V-6$. THIS TUBE, ITS CATHODE POTENTIAL REGULATED BY $V-7$, THEN DRAWS A HIGHER PLATE CURRENT CAUSING A DIP IN VOLTAGE AT THE PLATE OF $V-6$ AND GRID OF $V-5$. THIS DECREASE IN $V-5$ GRID VOLTAGE LOWERS ITS PLATE CURRENT REDUCING THE VOLTAGE DEVELOPED ACROSS $R-11$.

SINCE $R-11$ IS ALSO THE BIAS RESISTOR FOR THE CONTROL TUBES, $V-2$, $V-3$ AND $V-4$, THEIR PLATE TO CATHODE RESISTANCE INCREASES, THEREBY LOWERING THE POWER SUPPLY'S OUTPUT VOLTAGE.

FOR A DECREASE IN OUTPUT VOLTAGE, THE CONTROLLING ACTION DESCRIBED ABOVE IS REVERSED. SINCE $R-15$ CONTROLS THE GRID BIAS ON $V-6$, IT MAY BE USED TO SET THE D-C OUTPUT VOLTAGE TO THE REQUIRED VALUE.

C. MAINTENANCE

1. VOLTAGE ADJUSTMENT. THE SETTING OF $R-15$ DETERMINES THE D-C VOLTAGE OUTPUT OF THE POWER SUPPLY. TO ADJUST $R-15$, CONNECT A D-C VOLT METER AT THE $B+$ TERMINALS ON THE ASSOCIATED EQUIPMENT; WITH ALL POWER ON AND POWER SUPPLY UNDER FULL LOAD, SET $R-15$ TO THE REQUIRED VOLTAGE INPUT FOR THE ASSOCIATED EQUIPMENT.

2. TROUBLE LOCATION. THE FOLLOWING CHART SHOULD AID IN LOCATING TROUBLES IN THE POWER SUPPLY:

SYMPTOM

1. ZERO D-C OUTPUT VOLTAGE FROM POWER SUPPLY; NO HEATERS LIGHT.
2. ZERO OUTPUT VOLTAGE. ALL TUBES LIGHT.
3. LOW OUTPUT VOLTAGE. ALL TUBES LIGHT.
4. VOLTAGE OUTPUT HIGHER THAN NORMAL. POOR REGULATION.
5. EXCESSIVE RIPPLE IN D-C OUTPUT.

PROBABLE CAUSE AND CORRECTION

CHECK FUSE; CHECK $V-1$ FOR SHORT. CHECK A-C WIRING; CHECK $T-1$ AND $T-2$.

CHECK $V-1$. CHECK $C-2$, $C-3$ AND $C-5$ FOR SHORTS. CHECK FOR OPEN HV WINDING ON $T-1$; CHECK ASSOCIATED EQUIPMENT FOR $B+$ SHORT.

CHECK TUBES $V-1$, $V-2$, $V-3$, $V-4$, $V-5$, $V-6$ AND $V-7$. CHECK $C-4$ AND $C-6$ FOR SHORTS. CHECK $R-15$, $R-17$.

CHECK $I-1$ OR $I-2$. OPEN $R-15$. CHECK TUBES $V-5$, $V-6$ AND $V-7$.

CHECK $C-1$ AND $C-2$. CHECK FOR EXCESSIVE LOAD ON SUPPLY.

200A - POWER SUPPLY PARTS LIST

CAPACITORS

C-1 6UF, 600V, OIL-FILLED
C-2 2UF 600V, OIL-FILLED
C-3 .01UF, 500V DISC CERAMIC
C-4 0.1UF, 400V, MOLDED PAPER
C-5 (A - 20UF, 450V, ELECTROL.
(B - 20UF, 450V, ELECTROL.
C-6 1000UF, CERAMIC, 500V

TUBES

V-1 5U4G
V-2 6AQ5
V-3 6AQ5
V-4 6AQ5
V-5 12AU7
V-6 6AG5
V-7 OD2

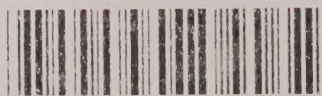
RESISTORS. (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE SIT10N, 10% TOLERANCE RESISTORS)

R-1 300K, 1W
R-2 100
R-3 33, 1W
R-4 33, 1W
R-5 100
R-6 33, 1W
R-7 33
R-8 100

R-10 33, 1W
R-11 150K, 1W
R-12 270K
R-13 6.8K, 1W
R-14 12K, 2W
R-15 100K, VARIABLE, B+ ADJ.
R-16 330K, 1W
R-17 91K, 5%

MISCELLANEOUS

F-1 FUSE: 3A; 250V
I-1 NEON GLOW LAMP, G-E NE2
I-2 NEON GLOW LAMP, G-E NE2
L-1 8.5 H AT 200 MA D-C; 120 OHMS D-C RESISTANCE
T-1 HV - TRANSFORMER (KA-2520)
J-1 JONES S-306AB



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